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| ART UNIT | PAPER NUMBER |
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1765

DATE MAILED: 05/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

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|------------------------------|-------------------------------|------------------------------|--|
| Office Action Summary | Application No. 09/964,918 | Applicant(s) GRANT ET AL. | |
| | Examiner Binh X Tran | Art Unit 1765 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 April 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-43 is/are pending in the application.
- 4a) Of the above claim(s) 35-43 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4, 8-13, 17-24 and 27-34 is/are rejected.
- 7) ☒ Claim(s) 5-7, 14-16, 25 and 26 is/are objected to.
- 8) ☒ Claim(s) 1-43 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>09-27-2001</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of Group I (claims 1-34 in Paper filed on 4-15-2004 is acknowledged. The traversal is on the ground(s) that "the search and examination of the entire application could be made without serious burden". This is not found persuasive because searching and examining both group I (process claims) and group II (product claims) certainly creates serious burden on the examiner. Further, the in previous office action, the examiner show that process claims and product claims are distinct.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 35-43 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in Paper filed on 4-15-2003.

Claim Objections

3. Claim 3 is objected to because of the following informalities: In claim 3, the examiner suggests applicants to insert the period (".") at the end to the claim. Appropriate correction is required.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1-3, 10-12, 19-22, 24 are rejected under 35 U.S.C. 102(b) as being anticipated by Yu et al. (US 6,013,570).

Respect to claim 1, Yu teaches a method comprising the steps of:

forming a patterned hard mask layer (312) over a polysilicon (304) layer (fig 3b);
patterning the polysilicon layer to provide a hard mask-capped polysilicon line having a first width (W1) (Fig 3C, col. 7 lines 1-5);

isotropically removing portions of the polysilicon line to a second width (Fig 3E, col. 7 lines 8-18).

Respect to claim 2, Yu teaches that the second width is smaller the first width or the minimum width of the patterned photoresist layer (read on "sub-minimum groundrule"). Respect to claim 3, Yu teaches to remove the patterned hard mask layer (Fig 3G, col. 7 lines 28-30). Respect to claims 10 and 19, Yu teaches to form a gate dielectric layer (306) on the top of the substrate and forming polysilicon layer (304) over the gate dielectric. The limitation of claims 11-12, 20-21 has been discussed above. Respect to claim 22, Yu teaches to simultaneously remove a portion of the dielectric layer not covered by the polysilicon gate electrode and the patterned hard mask (Fig 3G). Respect to claim 24, Yu teaches the substrate is silicon (col. 6 lines 59-60).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 4, 13, 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu in view of Vahedi et al. (US 6,316,169)

Yu teaches the hard mask comprises oxide, nitride, or silicon oxynitride material (col. 10 lines 15-20). Yu does not explicitly teach the hard mask comprises silicon oxide. Vahedi discloses that the hard mask comprises either silicon oxide, or silicon nitride or silicon oxide nitride (col. 5 lines 25-30). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Yu in view of Vahedi by using silicon oxide because equivalent and substitution of one for the other would produce an expected result.

9. Claims 8, 17, 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu in view of Meikle (US 5,942,449).

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Respect to claims 8, 17 and 27, Yu fails to disclose that the isotropic polysilicon etching step is performed by using etching solution comprises HF, HNO₃, and H₃PO₄. However, Yu clearly teaches that any conventional isotropic etching process can be used (col. 7 lines 15-18). Meikle teaches to use solution of HF, HNO₃ and H₃PO₄ to etch polysilicon layer (col. 4). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Yu in view of Meikle by using solution of HF, HNO₃ and H₃PO₄, because it provides good etching uniformity.

The above claims differ from the cited prior art by the specific amount of HF, HNO₃ and H₃PO₄. Meikle teaches the specific amount of the etching components is result effective variables (col. 4 lines 45-60). For example, Meikle teaches to change the etching components ratio to control the etching rate, specifically adjusting the ratio of phosphoric acid to nitric acid to hydrofluoric acid between 50:50:05 to 150:150:5, respectively to control the etching rate (col. 4 lines 35-40, col. 4 lines 50-55). The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiment to obtain optimal amount of HF, HNO₃ and H₃PO₄.

10. Claims 9, 18, 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu in view of Nakatani (US 6,446,641).

Respect to claims 9, 18 and 28, Yu fails to disclose that the isotropic polysilicon-etching step is performed by using etching solution comprises NH₄OH, H₂O₂ and water.

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However, Yu clearly teaches that any conventional isotropic etching process can be used (col. 7 lines 15-18). Nakatani teaches to use solution of NH_4OH , H_2O_2 and water to etch polysilicon layer (col. 6 lines 45). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Yu in view of Nakatani by using solution comprises NH_4OH , H_2O_2 and water, because it reduces the defect in the gate oxide layer.

The above claims differ from the cited prior art by the specific amount of NH_4OH , H_2O_2 and water. As discussed above (under Meikle reference), the specific of amount of etching components is result effective variables. The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, to perform routine experiment to obtain optimal amount of NH_4OH , H_2O_2 and water

11. Claims 29-32, 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu in view of Couteau et al. (US 6,352,867).

Respect to claim 29, Yu fails to teach the step of comparing the first width to a target width and determining a variation, calculating the etching time and then performing the etching for the calculated time. Couteau teaches to compare the width and determining the variation in the width of the gate, calculating the etching time and then performing the etching for the calculated time (Fig 4). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Yu in view of

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Couteau by implementing the above steps since these steps will allow us to control the feature size of the electrode. The limitations of claims 30-32, 34 have been discussed above.

12. Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yu and Couteau as applied to claim 29 above, and further in view of Vahedi et al. (US 6,316,169).

Respect to claim 33, Yu teaches the hard mask comprises oxide, nitride, or silicon oxynitride material (col. 10 lines 15-20). Yu does not explicitly teach the hard mask comprises silicon oxide. Vahedi teaches the hard mask comprises either silicon oxide, or silicon nitride or silicon oxide (col. 5 lines 25-30). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Yu in view of Vahedi by using silicon oxide because equivalent and substitution of one for the other would produce an expected result.

Allowable Subject Matter

13. Claims 5-7, 14-16, 25-26 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

14. The following is a statement of reasons for the indication of allowable subject matter: The cited prior arts fail to disclose or suggest either one of the following step in conjunction with all other limitation in the claim: converting a surface of the polysilicon line to an oxide layer and isotropically etching the oxide layer, or treating the polysilicon

line in saturated aqueous solution of O_3 following by etching in a HF solution or HF containing vapor.

Conclusion

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X Tran whose telephone number is (571) 272-1469. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Binh X. Tran

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER

